

Table S1 PCR primers used in the study.

<b>Primer Name</b>	<b>Sequence (5' – 3')</b>	<b>Reference</b>
Bac8F	AGAGTTGATYMTGGCTCAG	Juretschko et al., 1998
Bac338Rabc	GCWGCCWCCCGTAGGWGT	Daims et al., 1999
Arch806F	ATTAGATAACCSBGTAGTCC	Takai & Horikoshi, 2000
Arch958R	YCCGGCGTTGAMTCCAATT	DeLong, 1992
MS1b 585F	CCGGCCGGATAAGTCTCTT GA	Conklin et al., 2006
Sae 835R	GACAACGGTCGCACCGTGGCC	Conklin et al., 2006
MCC495F	TAAGG GCTGG GCAAGT	Yu et al., 2005
MCC832R	CACCT AGTTC GCAGAGTTA	Yu et al., 2005

Table S2 Thermodynamic data of aqueous educts and products under standard conditions.

<b>Compound</b>	$\Delta G_f^\circ$ (kJ mol <sup>-1</sup> )	$\Delta H_f^\circ$ (kJ mol <sup>-1</sup> )	$\Delta V_f^\circ$ (cm <sup>3</sup> mol <sup>-1</sup> )	<b>Reference</b>
CH <sub>3</sub> COO <sup>-</sup>	-369.4	-486.4	40.5	Shock and Helgeson (1990)
HCO <sub>3</sub> <sup>-</sup>	-586.9	-692.0	24.6	Wagman et al. (1982), Shock et al. (1997)
H <sub>2</sub> O	-237.18	-285.83	18.02	Amend and Shock 2001
H <sup>+</sup>	0.0	0.0	0.0	Shock et al. (1997)
H <sub>2</sub>	17.6	-4.2	25.2	Wagman et al. (1982), Shock and Helgeson (1990)
CH <sub>4</sub>	-34.47	-87.96	37.3	Shock and Helgeson (1990)
SO <sub>4</sub> <sup>2-</sup>	-744.96	-910.21	13.88	Shock et al. (1997)
HS <sup>-</sup>	11.97	-16.12	20.65	Shock et al. (1997)

Table S3 Standard free energy of reaction ( $\Delta G^\circ$ ), standard enthalpy of reaction ( $\Delta H^\circ$ ) and standard volume of reaction ( $\Delta V^\circ$ ) data of aqueous educts and products under standard conditions.

<b>Reactions</b>	<b><math>\Delta G^\circ</math> (kJ mol<sup>-1</sup>)</b>	<b><math>\Delta H^\circ</math> (kJ mol<sup>-1</sup>)</b>	<b><math>\Delta V^\circ</math> ( mol<sup>-1</sup>)</b>
$\text{CH}_3\text{COO}^- + 4 \text{H}_2\text{O} \rightarrow 4 \text{H}_2 + 2 \text{HCO}_3^- + \text{H}^+$	214.70	229.12	37.42
$\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightarrow \text{CH}_4 + \text{HCO}_3^-$	-14.74	-7.70	3.38
$4 \text{H}_2 + \text{SO}_4^{2-} + \text{H}^+ \rightarrow \text{HS}^- + 4 \text{H}_2\text{O}$	-262.06	-232.59	-21.95
$\text{CH}_3\text{COO}^- + \text{SO}_4^{2-} \rightarrow \text{HS}^- + 2 \text{HCO}_3^-$	-47.36	-3.47	15.47
$\text{HCO}_3^- + 4 \text{H}_2 + \text{H}^+ \rightarrow \text{CH}_4 + 3 \text{H}_2\text{O}$	-229.44	-236.82	-34.04